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HUMAN FACTORS AND TRAINING RESEARCH IN  
MILITARY ORGANIZATIONS AND SYSTEMS

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report summarizes the resulting five research projects conducted between March 1979 and February 1980. Separate, more detailed reports describing the work in each of the five areas are being published concurrently. These reports are: "Preliminary Development of the Commander's Unit Analysis Profile: A Leadership Tool for the Small Military Unit"; "The Impact of Adopting Physical Fitness Standards on Army Personnel Assignment: A Preliminary Study"; "Testing and Training Methods for Skill Qualification Testing"; "Reading Ability and Other Correlates of the SQT Written Component"; "Development of a Basic Training																	

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Program in Combat Vehicle Identification"; and "Improvement of Training Realism for Tactical Units: Opposing Force (OPFOR) Program."

# FINAL REPORT: HUMAN FACTORS AND TRAINING RESEARCH IN MILITARY ORGANIZATIONS AND SYSTEMS

## Foreword

The Fort Hood Field Unit of the US Army Research Institute for the Behavioral and Social Sciences (ARI) conducts research in a variety of areas related to the needs of the Army in the field and provides support to Headquarters, TCATA (TRADOC Combined Arms Test Activity). This support is provided by assessing human performance aspects in field evaluations of man/machine weapons systems.

This report summarizes the results of five research efforts conducted in support of the ARI Field Unit at Fort Hood. Separate, more detailed reports describing the work in each of the five areas are being published concurrently. In brief, the five research projects were concerned with Skill Qualification Testing, physically demanding Army jobs, Opposing Forces (OPFOR) training programs, soldiers' opinions of unit status on factors affecting unit effectiveness, and the development of a training program in vehicle recognition and identification.

ARI research in these areas is conducted as an in-house effort, and as joint efforts with organizations possessing unique capabilities for human factors research. The research described in this report was done by personnel of the Human Resources Research Organization (HumRRO), under Contract MDA903-79-C-0191. This research is responsive to the objectives of RDTE Projects 2Q262717A765, 2Q263739A793, and 2Q262731A792, "Human Performance in Field Assessment," FY 1979 and 1980 Work Programs.



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# FINAL REPORT: HUMAN FACTORS AND TRAINING RESEARCH IN MILITARY ORGANIZATIONS AND SYSTEMS

## Executive Summary

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### Requirements:

During the decade of the 1980s the US Army faces the prospect of budgets that are not in keeping with inflation, insufficient manpower resources, and a threat with ever increasing technological sophistication. In order to meet these challenges, it is imperative that the Army be able to "get the most" from both its personnel and equipment. To do this, training must be highly effective, personnel utilization must be optimized, and man/machine interface problems must be reduced to a minimum. The US Army Research Institute for the Behavioral and Social Sciences (ARI) conducts research, both in-house and through contracts, in these areas. This report summarizes the work on five projects designed to help the Army meet its needs for the 1980s.

### Procedure:

Each staffmember was assigned primary responsibility for one of the research areas. A significant portion of time in several of the efforts was devoted to the search for and accumulation of relevant information. Information was sought through the Defense Technical Information Center (DTIC), University of Texas libraries, the HumRRO library in Alexandria, Virginia, and through personal contacts. Reviews of the documentation are included as appropriate in each report. Effort was also expended in the planning and execution of field and laboratory studies, and in the analysis of the resulting data.

### Findings:

- Development and Evaluation of Unit Training Programs for Skill Qualification Testing. One part of this effort examined the relationships between reading ability scores and SQT scores. Reading ability correlated substantially with the Written Component ( $r = .46$ ). A smaller but significant correlation was found with the Hands On Component ( $r = .25$ ). This latter finding suggests that general ability, aside from reading ability, plays a role in success on the SQT.

A second part of this research was devoted to the development of a battalion training strategy based on the performance-oriented model. A form of procedural testing was developed that combines the convenience of multiple-choice scoring with some advantages of hands-on testing.

- The Impact of Adopting Physical Fitness Standards on Army Personnel Assignment. This research examined proposed physical selection standards to determine their potential impact on the availability of personnel, especially in MOSs requiring high mental aptitude. It was concluded that the impact could be severe. A job-analytic approach was suggested as a possible alternative. Realignment of tasks between MOSs was seen as one way of reducing the demands for high mental aptitude MOSs. The development of job aids to reduce physical demands was also seen as a fruitful approach.

- Improvement of Training Realism for Tactical Units: Opposing Force (OPFOR) Program. This project attempted to develop a performance-oriented procedure to aid training managers in developing their own OPFOR-related training. The procedure essentially described methods for relating OPFOR knowledges and skills to tasks on MOS task lists. The techniques proved to be relatively useful upon application, but had some shortcomings. A major problem was that task descriptions for US Army tasks were so general that it was difficult to specify the required behaviors and associated knowledges.

- Preliminary Development of the Commander's Unit Analysis Profile: A Leadership Tool for the Small Military Unit. A 99-item questionnaire designed to assess soldier opinions on unit standing with reference to a large number of situational and personnel factors was constructed. Responses by 674 soldiers were factor analyzed. A total of 22 factors was interpreted. Forty-nine items representing the authors' judgments of the "best" measures of each factor were selected. A factor analysis of the 49 items resulted in the emergence of 21 of the original 22 factors. The 49 items were recommended for further study.

- Development of a Basic Training Program in Combat Vehicle Identification. Early research on long range vehicle recognition and identification (R&I) suggested a need for more effective training for aircrewmembers. A prototype modularized training program employing 35mm slides was developed. Requests for the training materials from a wide variety of other units indicated an Army-wide need. The program was revised and packaged for a field evaluation. The program was called the CVI Training Program (for Combat Vehicle Identification). Preliminary results indicate that the program is effective and can serve the needs of any personnel whose duties encompass the identification of vehicular targets on the battlefield.

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## FINAL REPORT: HUMAN FACTORS AND TRAINING RESEARCH IN MILITARY ORGANIZATIONS AND SYSTEMS

### Development and Evaluation of Unit Training Programs For Skill Qualification Testing

Background and Problem. Skill Qualification Testing (SQT) is widely acknowledged as a significant advance over the previous "knowledge-based" MOS tests. As a "criterion-referenced" system, SQT is concerned with measuring the skills actually used on the job, applying the standards needed for successful performance.

Commanders have complained that the Written Component (WC) still depends too much upon reading ability, despite its practical orientation. One consequence of the criticism has been to reduce the length of WC and its importance in the scoring. However, written tests such as the WC have some unique advantages, including convenience and ease of scoring. Also, the written component seems to be content-valid for some kinds of skills (i.e., it involves exactly the same operations as the military task being tested). Therefore, it would be desirable to distinguish the kinds of tasks where WC testing is quite satisfactory, and the kinds of tasks where the Hands-On Component (HOC) testing is required. Hands-on testing certainly has face validity, but it should be used only when necessary because of difficulties in developing and administering hands-on tests.

A research effort was mounted which had two primary objectives. The first objective was to determine the relationships between reading ability, selected personal factors, factors in preparation for the SQT, and actual SQT scores. The second objective was to distinguish the kinds of tasks and items where WC testing is content-valid, and the most cost-effective method of testing. This objective included the development of a method for eliminating difficult reading required in WC that was not a part of the job, and the development of unit training strategies for SQT preparation.

Procedure. A computerized data base was established in previous work which included SQT scores, scores on a standardized reading test, demographic data, and responses to a questionnaire concerning (a) preparation for SQT, (b) satisfaction with the Army as a career, and (c) difficulty in understanding questions in the WC and Soldier's Manuals. Statistical techniques were used to determine significant correlates of SQT performance. The analyses performed were relevant to the first objective.

To meet the second objective, classification systems for tasks and test items were developed as aids in deciding when to use WC testing. These systems were based on the content of the 1977 SQT2 for MOS IIB, IIC, and IIE. An SQT training strategy was derived from the performance-oriented model, including refinements in training and testing that are needed for implementation.

Results. Reading ability correlated substantially with WC scores (overall  $r = .46$ ), but much of that relationship may be explained in terms of general ability, since it also correlates significantly with scores on the HOC ( $r = .25$ ). Soldiers who reported having difficulty understanding WC questions in their Soldier's Manuals (SM) tended to score



lower on the WC. Soldiers who got their SM earlier tended to score better on the WC. WC scores bore no appreciable relationship with soldiers' opinions about their SQT training, with career satisfaction, with civilian education, with age, or with time in service.

It was concluded that many kinds of tasks may be validly tested with WC, where HOC is either infeasible or unnecessary. WC questions may be simplified by eliminating extraneous expressions and by integrating answer choices with illustrations. A form of procedural testing was developed that combines the convenience of multiple-choice scoring with other advantages of hands-on testing. A battalion training strategy was derived from the performance-oriented model, but its implementation will require development of efficient diagnostic testing procedures for use in units.

### **The Impact of Adopting Physical Fitness Standards on Army Personnel Assignment: A Preliminary Study**

Background and Problem. A program to develop physical demand standards for Army Military Occupational Specialties (MOSs) and selection procedures for selecting persons with adequate physical fitness to do these jobs is now being conducted by the Army Research Institute for Environmental Medicine (ARIEM). To date, not only have the MOSs that have been traditionally considered to be arduous, such as those in the combat arms, been classified as physically demanding, but also so have many highly technical MOSs in the medical, transportation, communication and intelligence fields. Any selection procedure that affects such a broad range of specialties is bound to have a profound effect on the Army's total personnel assignment policy.

The initial objective of this research program was to assess what the impact of adopting physical demand standards would be on the availability of personnel for critical MOSs. This was done by analyzing the number of personnel who would be affected by selection and what the existing literature on physical fitness predicted about the ability of current soldiers to meet the fitness standards.

Procedure. ARIEM provided a description of the physical demand categories derived, a list of MOSs assigned to each demand category, and a summary of the tasks in each MOS that resulted in the classification. A list of the number of personnel in each MOS and the mean AFQT score for males and females in each one was obtained from the Defense Manpower Data Center. From these lists it was possible to determine the number of persons falling into each physical demand category and the average aptitude scores by MOS.

The potential impact of screening on the basis of physical demand standards was determined by examining the research literature on physical fitness. The two areas covered by the inferred ARIEM standards, stamina and strength, were examined separately. From these data an estimate of the proportion of soldiers able to pass each of the standards was derived. The literature on job selection procedures for physical characteristics was also reviewed to determine what the characteristics of a desirable policy would be.

By comparing the number of people available for selection and who pass the requirements with the number required to meet MOS authorization, it was possible to assess the potential impact of the system. In doing this, it was assumed that the higher the average aptitude of incumbents in an MOS, the more difficult it would be to find persons able to carry out the job. It also was assumed that the Army is unlikely to find more persons with above average aptitude than it currently has.

**Results.** The principal findings indicated that selection on the basis of the standards would have a severe impact on the availability of personnel, especially in MOSs requiring high mental aptitude. These findings were:

- a. Only the strength requirement would have any impact on selection. The medium strength requirement might be passed by as few as 54 percent of the males and one percent of the females. The highest stamina requirement, by contrast, would be passed by up to 99 percent of the males and 80 percent of the females.
- b. Far too many MOSs were classified as having high or medium strength demands for a selection procedure to work. For example, 76 percent of the current enlisted personnel would be required to meet at least the medium strength requirement.
- c. A large proportion of the MOSs categorized as physically demanding also require high aptitude for success. Sixty-seven percent (67%) of the soldiers who would be required to have medium strength or higher also fall in the 16 percent of the jobs for which the mean aptitude score is above the 60th percentile.

A job analysis approach was presented as an alternative. It would:

- a. Identify the specific physical tasks that cause an MOS to be classified as physically demanding.
- b. Suggest modifications for jobs so that they no longer have high physical demand requirements, particularly in the case where they also have high aptitude requirements.
- c. Keep the proportion of jobs classified as physically demanding down to a size where selection procedures could be expected to work.

Implementation of the recommendations of this report would have the side benefits of reducing on-the-job injuries from overexertion and reducing the probability that the Army could be sued successfully for sexual discrimination on the basis of the job requirements.

#### **Improvement of Training Realism For Tactical Units: Opposing Force (OPFOR) Program**

**Background and Problem.** AR 350-2, OPFOR Program, established the Army-wide Opposing Force (OPFOR) program. The purpose of the program is to focus training on the

tactical capabilities and vulnerabilities of our foremost potential adversaries. The ultimate goal is to prepare US Army units to win outnumbered by familiarizing US soldiers with Soviet doctrine, tactics, and weapons systems, and by providing them with an uncooperative, competitive, and whenever possible, numerically superior force against which to maneuver.

At present, the Army Training and Evaluation Programs (ARTEPs) guide the training and evaluation of US Army units. However, at present, ARTEPs contain no OPFOR-related training objectives. As a result, training managers have no basis for designing OPFOR-related training, and evaluation personnel have no behavioral criteria for judging troop and leader knowledge of OPFOR or ability to counter an opposing force. Lack of OPFOR-related knowledges and skills could be a decisive factor on the battlefield. Therefore, OPFOR-related training objectives need to be derived and integrated into training for all fundamental missions of combat and combat support units. This research was undertaken to develop procedures for deriving OPFOR-related training objectives that could be employed by training managers Army-wide. This research was requested by FORSCOM's Opposing Force Detachment, Red Thrust, located at Fort Hood, Texas. The Detachment is charged with the responsibility for collecting and disseminating OPFOR information, and for advising commanders Army-wide in the development of OPFOR training programs.

Procedure. Original plans called for the development of specific OPFOR-related training objectives for selected tasks from a battalion ARTEP, and time permitting, the development of some prototype training materials to serve as examples for training developers. ARTEP 71-2, Mechanized Infantry/Armor Task Force, was chosen as the vehicle for the research. However, on close examination it was found that the OPFOR scenario lacked sufficient detail to permit the specification of the OPFOR-related tasks to be performed by US forces. Nevertheless, certain tasks, e.g., vehicle identification, were obviously required in combat.

At this point, the thrust of the research was changed. Work was initiated on the development of a performance-oriented procedure for developing OPFOR-related training. Nuclear, Biological, and Chemical (NBC) warfare was chosen as the vehicle for developing the procedure. The application of the procedure for NBC training was essentially completed. The procedure involved the following steps:

- a. Develop a list of all US Army tasks related to NBC warfare from all available sources.
- b. Collect all available information on OPFOR intentions, tactics, and weapons in the area of NBC warfare.
- c. Determine which items of OPFOR information are required either to optimize performance or provide relevance to the training for each of the US tasks.

Results. The procedure developed proved to be relatively useful upon application. However, a number of problems were noted:

- a. The tasks in the lists obtained from US Army schools and the research literature were often stated in such general terms that

the required behaviors and associated knowledges were extremely difficult, if not impossible, to specify.

- b. There was considerable disagreement on how OPFOR information should be classified and on what information was "essential" to performance in each of the tasks.
- c. The task lists were found to be incomplete. Additional tasks (not on any of the lists) could be inferred from the OPFOR information.

It was concluded that the procedure would provide training managers with a useful tool for beginning OPFOR-related training developments. However, it was felt that additional tasks would probably have to be derived in most content areas. A likely source appeared to be the observation of simulated combat exercises pitting a US force against a well-trained force employing OPFOR doctrine and tactics.

#### **Preliminary Development of the Commander's Unit Analysis Profile: A Leadership Tool For the Small Military Unit**

**Background and Problem.** Operational readiness and other aspects of overall unit effectiveness can be affected by a host of situational and personnel factors. Commanders have some degree of control over most of these factors. However, they may not know what factors are influencing the performance of their units, either positively or negatively. As a result, they do not know what kinds of corrective actions to take and what kinds of changes to avoid. At present, voluntary feedback is the only mechanism by which the commander can obtain such information. While voluntary feedback is undoubtedly useful, voluntary reports are typically negative, and more often than not represent the opinions of only a vocal minority. Therefore, they may not be representative of the majority of the unit's personnel. Commanders need a means of obtaining information that is representative, and that will permit them to compare their units to other similar units on those situational and personnel factors that influence unit effectiveness. A brief, easily scored, and anonymously administered questionnaire appears to be the best available means for providing commanders with this information. This report describes an initial phase of research directed toward this end.

**Procedure.** A questionnaire designed to assess soldier opinions on unit standing with reference to a host of situational and personnel factors was constructed. The questionnaire was administered to 674 soldiers in 21 companies at Fort Hood, Texas. The data were factor analyzed in an effort to determine what factors were actually being assessed by the items, and to determine which items were the best measures of each of the factors.

Two additional analyses are in progress. One of these is an examination of the response distributions to each item in an effort to determine if and why any item might have been misinterpreted. The other analysis is examining the relationships of each item to external criteria of effectiveness such as AWOL rates, reenlistment rates, and battalion commanders' ratings. The results of these analyses will be reported separately.

**Results.** The original analysis of the 99-item questionnaire yielded 23 factors. Twenty-two of these factors were interpreted and named, although the interpretation of

some of the minor factors were made with reservations. The sample was divided in half, and one half was analyzed in the same manner. Twenty of the original 22 factors emerged, partially confirming the existence of the major factors in the entire sample.

The next step was to select items which appeared to be the best measures of each of the 22 factors. A total of 49 items were selected. These items were again factor analyzed, and 21 of the original 22 factors emerged. This demonstrated that the length of the questionnaire can be considerably reduced with a minimal loss of information.

Based on the results of this analysis, it was possible to suggest directions for the development of a revised questionnaire.

### **Development of a Basic Training Program in Combat Vehicle Identification**

Background and Problem. ARI research on vehicle recognition and identification (R&I) at Fort Hood was initiated in an effort to determine whether aircrewmembers could accurately identify vehicular targets at or near the maximum range of the newly acquired TOW weapons system on the attack helicopter. This early research employed scale model vehicles presented at scaled ranges typical of engagement. It was found that the aircrewmembers, though presumably well trained, had considerable difficulty in identifying the vehicles at first. Discussions with the participants revealed that their prior training had taught them to identify vehicles on the basis of cues that could be seen at close ranges, but not at the simulated tactical ranges employed in the research. Working with the participants, lists of cues that could be seen at long ranges were developed. These cues formed the basis of an R&I training program used in later phases of the research.

The participants in the research program almost universally felt that the R&I training they received was the best they had ever experienced. As a result, the sponsor requested that the experimental techniques be adapted for classroom use.

Procedure. A prototype program was constructed which was designed to train soldiers to recognize and identify vehicles employing only those cues which could typically be seen at tactical ranges. The program employed 35mm slides of 25 model vehicles presented on a realistic terrain board. Each vehicle was shown in five aspect angles (right side, right oblique, front, left oblique, and left side). The program was modular in design, with each module containing materials for five vehicles. Complete scripts were provided for the instructor. A means of sizing the images was provided so that an instructor could simulate virtually any range and optical power desired.

Results. As the existence of the prototype program became known, many requests for the materials were received. As a result, 25 copies of the program were packaged, and over 20 military units (Army, Air Force, Marines) who had requested the training materials were invited to participate in an evaluation of the program. The training program became known as the CVI Training Program (for Combat Vehicle Identification). The results of this evaluation are being reported separately.

## BIBLIOGRAPHIC INFORMATION

The reports summarized can be identified separately by the following information:

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